

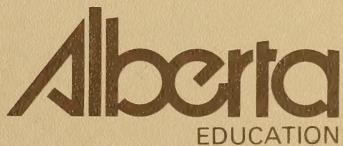
# Grade 6 Mathematics Achievement Testing Program

## Provincial Report

October 1983

Distribution:

- Officials of Alberta Education
- School Principals
- Superintendents of Schools
- The Alberta Teachers' Association
- Alberta School Trustees' Association
- General Public upon Request





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## EXECUTIVE SUMMARY

### Findings

- The provincial average is 60.7% for the test, excluding the section on basic facts.
- Student performance on the questions involving addition, subtraction, and multiplication of large numbers is higher than on those involving division.
- Student scores on questions involving perimeter and area of polygons are considerably below the test average.
- Students found it easier to complete a bar graph than to solve problems using pictographs and circle graphs.
- The provincial averages for the tests on basic facts are as follows:

Addition -	94.1%
Subtraction -	90.8%
Multiplication -	90.5%
Division -	86.3%
Mixed Operations -	88.3%

### Organization of the Test

The test is organized into two sections.

Section I has 45 questions on the five subject strands of the curriculum:

Numeration -	11 questions
Operations and Properties -	15 questions
Measurement -	9 questions
Geometry -	5 questions
Graphing -	5 questions

Section II has five timed tests that measure recall of basic facts in:

Addition -	16 questions
Subtraction -	16 questions
Multiplication -	24 questions
Division -	24 questions
Mixed Operations -	20 questions

### Results for Subject Strands

The provincial average for Section I of the test is 60.7%. The provincial averages for the subject strands are as follows:

Numeration -	55.4%
Operations and Properties -	68.2%
Measurement -	57.0%
Geometry -	58.3%
Graphing -	59.1%

### Comparison with the 1978 MACOSA Results

In 1978, a similar achievement test was administered to Grade 6 mathematics students. Ten questions from this 1978 test are on the 1983 test. The averages for those 10 questions are as follows:

<u>1978</u>	<u>1983</u>
54.5%	64.1%

### Comparison with the 1982 Grade 3 Mathematics Results

Four questions from the 1982 Grade 3 Mathematics Achievement Test are on the 1983 Grade 6 test. The averages for these questions are as follows:

<u>Grade 3</u>	<u>Grade 6</u>
45.3%	67.2%

### Results for Basic Facts

The provincial averages are 94.1% on addition, 90.8% on subtraction, 90.5% on multiplication, 86.3% on division, and 88.3% on mixed operations. The percentages of students achieving the 80% and 100% mastery levels are given below:

Percentage of Students  
80% mastery      100% mastery

Addition	94.4	72.9
Subtraction	90.9	62.8
Multiplication	84.5	51.2
Division	80.7	45.8
Mixed Operations	83.7	45.0

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## PREFACE

This report presents the provincial results of the Grade 6 Mathematics Achievement Test administered on June 14, 1983, as part of the Student Achievement Testing Program conducted by Alberta Education. The results are reported for 25 621 students in public and separate schools.

The report has an executive summary and three chapters. The Executive Summary contains a brief description of the Grade 6 mathematics program and test, and summarizes the results. Chapter 1 describes the Achievement Testing Program. Chapter 2 outlines the procedures followed in test development, describes the Grade 6 Mathematics Achievement Test, and defines the sample. The results are presented in Chapter 3, with guidelines for interpretation.

#### ACKNOWLEDGEMENTS

The successful administration of the Grade 6 Mathematics Achievement Test was the result of the concerted effort of all involved. Success would have been impossible without substantial contributions from many people, particularly the students, teachers, and administrators who extended their full co-operation.

The technical expertise of Dr. T. O. Maguire, Professor, Division of Educational Research Services, University of Alberta, has been particularly valuable in the implementation of the Achievement Testing Program. His contributions to the design, analysis, and reporting are gratefully acknowledged.

Lloyd E. Symyrozum  
Director  
Student Evaluation Branch

## Chapter 1

### THE ACHIEVEMENT TESTING PROGRAM

#### Purpose

The Achievement Testing Program is designed to provide data on student achievement in language arts, social studies, mathematics, and science for Grades 3, 6, and 9. These data are significant at the local and provincial levels. The purpose of the testing is to monitor the effectiveness of instructional programs by determining the extent to which curricular objectives are being achieved. Since averages are reported for a number of specific topics and skills within each subject area, strengths and weaknesses across the province and within each jurisdiction can be identified. The results provide provincial standards and benchmarks that will serve as a basis for the long-term appraisal of student achievement. These standards will help jurisdictions to evaluate the effectiveness of their local programs.

#### 1983 Tests

Each test is based on the curriculum as outlined in the *Program of Studies* for the subject and grade being tested. Only one subject at any grade level is tested in a given year. The full program of testing is accomplished within a four-year cycle. In 1983, tests were given in Grade 3 science, Grade 6 mathematics, and Grade 9 social studies.

Tests are administered in June, and the results are reported in the fall. A summary report is prepared for public distribution, and a more comprehensive report is issued to jurisdictions. Each jurisdiction receives summary tables for that jurisdiction and for each school, as well as student scores. Alberta Education does not issue individual statements of results to students.

#### Exemptions from Testing

Under normal circumstances, the following classes are exempt from achievement testing:

- Special Education classes registered for grants with the Special Educational Services Branch
- classes in which the language of instruction is other than English, under the terms of Section 159 of the *School Act*
- classes in which the subject being tested has been cycled and taught in an alternate year
- classes in which the subject has been taught in a semester other than that in which the test is being administered
- classes for students for whom English is a second language



## Chapter 2

### DESCRIPTION OF TEST AND SAMPLE

This chapter outlines the procedures that were followed during test development, describes the test, and describes the student sample that was used.

#### Test Development

There were three stages in the development of the Grade 6 Mathematics Achievement Test: preparation of curriculum specifications, development of questions, and selection of questions for the final copy.

##### 1. Curriculum Specifications

The Curriculum Branch prepared curriculum specifications based on the *Program of Studies for Elementary Schools*. These specifications assigned weightings to each major subject strand and to specific topics outlined in the *Program of Studies*. These weightings indicated the emphasis that each topic was to receive in the program. The curriculum specifications were distributed to all school jurisdictions in the province and minor revisions were made on the basis of the feedback that was received. Topic statements from the curriculum specifications upon which specific questions were based are listed under each subject strand with the results in Chapter 3.

##### 2. Development of Questions

Committees composed of teachers and Student Evaluation Branch personnel constructed questions to reflect the topic statements listed in the curriculum specifications. Questions were also selected from existing tests and item banks. Another teacher committee examined the questions for content validity. Revisions were made on the basis of teacher recommendations and field-test results.

##### 3. Final Copy

The test was constructed by a committee of teachers and Student Evaluation Branch personnel from the approved questions. Questions were selected from the various content areas so that each received the emphasis recommended in the curriculum specifications. This version of the test was examined by a Technical Review Committee for content validity, accuracy, and technical merit. Additional changes were made to meet their recommendations.

#### Test Description

The test has two major sections: Section I covers the five subject strands that form the core of the Grade 6 mathematics curriculum; Section II measures student mastery of basic facts in addition, subtraction, multiplication, and division. All questions are multiple-choice with four alternatives. Student answers are marked on an answer sheet designed for machine scoring.

## Section I - Subject Strands

Section I, which consists of 45 questions, is written in two sittings. It covers the following five subject strands: Numeration, Operations and Properties, Measurement, Geometry, and Graphing. The specific content tested within each strand is identified in Chapter 3 with the results for Section I. The questions measure knowledge and comprehension of facts, concepts, and skills, and ability to apply knowledge and skills. Knowledge questions test recognition of facts or ability to do fundamental manipulations. Comprehension questions test understanding of concepts, application of algorithms, ability to translate from concrete to pictorial to symbolic representation, or to translate in the reverse order. Application questions test ability to solve problems; recognize patterns and relationships; or compare, analyze, and apply data.

The taxonomic classification of test questions depends on the manner in which the content has been covered in the classroom. A question that is an application question for one class may be a knowledge question for another class. Teachers should examine this classification to determine whether it is consistent with the way they taught the content.

The classification of questions is presented in Table 1.

Table 1  
Classification of Test Questions

Subject Strand	Number of Questions	Test Emphasis	Test Question Numbers by Taxonomic Level		
			Knowledge	Comprehension	Application
Numeration	11	25%	1,2,3,8,10,11	4,7,9	5,6
Operations and Properties	15	33%	22,23	12,13,15,16,18 20,21,24	14,17,19,25,26
Measurement	9	20%	33,34,35	28,30,32	27,29,31
Geometry	5	11%	37,39	36	38,40
Graphing	5	11%	-	44	41,42,43,45
TOTAL	45	100%	13	16	16

## Section II - Basic Facts

Section II consists of five timed tests measuring student mastery of the basic facts. The students are expected to know addition to  $9 + 9$ , subtraction to  $18 - 9$ , multiplication to  $9 \times 9$ , and division to  $81 \div 9$ . The test lengths are presented in Table 2 below.

Table 2  
Test Lengths for Basic Facts

Basic Facts	Number of Questions	Time in Minutes
Addition	16	1
Subtraction	16	1
Multiplication	24	2
Division	24	2
Mixed Operations	20	2

### Population and Sample

A total of 26 414 students was tested (25 621 from 913 public and separate schools and 793 from 74 private schools). The average absentee rate was 6%. Students from private schools are not included in the results presented in Chapter 3.

Each school jurisdiction was given the option of either testing all Grade 6 students or testing a sample of students selected by class or school unit. To ensure a minimal sampling error for jurisdiction results, however, it was necessary to test almost all the classes in small jurisdictions. Since there was little practical benefit to be derived from sampling in small jurisdictions, it was decided to test all classes. Two large jurisdictions opted for sampling: one chose to sample by class unit, and one chose to sample by school unit.

The sample of classes was obtained by randomly selecting one-third of the classes in the jurisdiction. The sample of schools was obtained through stratified sampling procedures to ensure that equal proportions of large and small schools were included in the sample. The schools in the jurisdiction were listed from largest to smallest and separated into strata containing six schools each. Two schools were randomly selected from each stratum, resulting in a sample consisting of one-third of the schools in the jurisdiction.

The standard error in the provincial mean due to sampling in the two jurisdictions is negligible, being less than 0.075% for all subtests.



## Chapter 3

### RESULTS

Results are reported for the 25 621 student test booklets that were received from public and separate schools. In computing provincial averages and percentages, the results from the two jurisdictions that used sampling were weighted to reflect the proportion of the students who were tested in these districts.

#### Guidelines for Interpretation of Results

Since many factors influence the performance of students within jurisdictions, setting standards is a difficult task. Some of these factors are listed below.

1. The tests were designed to sample the Grade 6 mathematics curriculum, but the amount of instruction given on each topic may vary from one class to another.
2. Any time a test is used to measure achievement, there are minor variations in the results because of such factors as guessing, clerical errors, and errors due to lapses of attention.
3. Since the average level of aptitude is more likely to fluctuate in smaller jurisdictions than in larger ones, small jurisdictions may notice unanticipated levels of achievement in a particular year.
4. Longer subtests are more reliable than shorter subtests in their estimation of average achievement.
5. The tests are necessarily paper-and-pencil representations of the skills developed in mathematics.

In view of these factors, it was decided that an average of 60% would be a reasonable target for subtest and total test scores. Since the jurisdiction averages are subject to the influences mentioned earlier, target regions have been set up to aid in the interpretation of results. For Total Test, Numeration, and Operations and Properties, the regions were set at two percentage points around the target. For the shorter subtests, the regions were set at five points around the target. Jurisdictions with fewer than 100 students writing should use differences of five and ten points to identify areas of strength and weakness. The target regions are given in Table 3.

Table 3  
Target Regions

Subtest	Number of Questions	Target Regions (%)	
		<100 Students	>100 Students
Total Test	45	55 - 65	58 - 62
Numeration	11	55 - 65	58 - 62
Operations and Properties	15	55 - 65	58 - 62
Measurement	9	50 - 70	55 - 65
Geometry	5	50 - 70	55 - 65
Graphing	5	50 - 70	55 - 65

To interpret results for a jurisdiction, the reader should first read the sample questions, examine the test specifications, and decide whether the target levels are appropriate for that jurisdiction. Next, the jurisdiction averages should be compared with the target values and those outside the target regions noted.

It must be emphasized that the purpose of the Achievement Testing Program is to produce results valid at the jurisdictional and provincial levels, not at the individual class or student level. Because of restrictions of time and space, the test questions are only a small sample of possible questions for any curricular objective. Thus, individual student scores on short subtests may vary greatly, depending on the specific question selected. Caution must be exercised when comparing averages for single class units because of the large variation in student ability from one class to another.

For large groups of students, variations because of question selection will average out. If the group size is sufficiently large, it is meaningful to compare the achievement of groups of students with the provincial averages. Again, the two- and five-point guidelines are useful for the larger jurisdictions and the five- and ten-point guidelines can be used by jurisdictions with fewer than 100 students. Jurisdictions with fewer than 25 students should exercise caution when comparing results with provincial averages. Jurisdictional results are presented in tables that parallel the tables of provincial results to facilitate comparisons.

When examining the results of the achievement tests, readers should keep in mind that a test score cannot reveal why a performance occurred, only that it did occur. After areas of strength and weakness have been determined, the difficult task of identifying the reasons for these strengths and weaknesses should be undertaken. A variety of factors should be examined.

1. Student motivation. Were students motivated to take the test?
2. Student ability. A group of students with a particularly high or low ability level may have been tested. This is much more likely to occur in small systems than in large ones.
3. Teaching curriculum. Since much care was taken in designing the test to fit the Alberta curriculum, areas of weakness may be the result of discrepancies between provincial and local programs.

There will, of course, be other factors that are of importance in particular jurisdictions. Jurisdictions are encouraged to establish local interpretation panels to examine the results in light of local factors.

#### Absentee Rates

If more than 10% of the eligible students in a jurisdiction did not write the test, the reported averages for that jurisdiction may not accurately represent the true averages. Teacher-assigned marks for students who did not write could be compared with teacher-assigned marks for students who did write. If the averages are the same for the two groups, the reported achievement averages are probably representative. If the averages are different, some estimates can be made of what the achievement averages might have been if all students had written the test. Jurisdictions with high absentee rates may wish to contact the Student Evaluation Branch for assistance in estimating their averages.

#### Cautions

The following cautions should be observed when examining the results for the Grade 6 Mathematics Achievement Test:

1. The findings are limited to those that can be obtained from a pencil-and-paper test; many skills developed in mathematics cannot be measured by this type of test.
2. The questions on the test cover a representative sample of the objectives for Grade 6 mathematics in the *Program of Studies for Elementary Schools*.
3. When differences between average scores for subtests are examined, consideration should be given to the following:
  - questions on a given topic may be exceptionally difficult or easy
  - a given topic may have been taught poorly or taught exceptionally well
  - a set of objectives may be too difficult for Grade 3 students to attain or may be trivial for Grade 3 students.

## Section I - Subject Strands

Over 97% of the students completed the test, indicating that sufficient time was allowed for this section. The KR-20 coefficient for Section I is 0.87. The standard error of measurement is 6.6%. The questions in this section have been grouped into subtests according to subject strand and taxonomic level. Provincial averages in per cent are reported in Table 4 for eight subtests and the total test. The number of questions in each subject is also given.

Table 4

### Provincial Averages for Subject Strands, Taxonomic Levels, and Total Test

Subtest	Number of Questions	Average (%)
Numeration	11	55.4
Operations and Properties	15	68.2
Measurement	9	57.0
Geometry	5	58.3
Graphing	5	59.1
Knowledge	13	57.7
Comprehension	16	64.2
Application	16	59.9
Total Test	45	60.7

The standard deviation for the total test is 18.6%.

The average for the total test is close to the target of 60%. The average for Operations and Properties is above the upper limits of the target region whereas the average for Numeration is below the lower limit of the target region. The averages for Measurement, Geometry, and Graphing are within the ranges of the target regions.

Within subject strands, the average is highest for Operations and Properties (68.2%), and lowest for Numeration (55.4%).

For the taxonomic levels, the average is highest for Comprehension (64.2%) and lowest for Knowledge (57.7%). Results for taxonomic levels within subject strands are not presented because the number of questions is too small.

The results for each subject strand are discussed in detail in the following sections. The topics that were tested within each strand are identified, and sample questions from the test are provided. The asterisk (\*) indicates the correct response for each question, and the percentage of students selecting each alternative is given. The easiest and most difficult questions within each subject strand are identified.

### Numeration

Questions related to Numeration measure ability to:

- identify and name place value to billions (0.0001 - 1 000 000 000)
- write decimal numerals using expanded notation
- round numbers (0.0001 - 999 999 999)
- identify and use proportional ratios
- express quarters as decimals
- express decimals as per cents
- identify and order integers
- read and write whole numbers and decimals (0.0001 - 1 000 000 000)

The following question is at the knowledge level, and measures ability to write numerical notations for whole numbers and decimals.

Question 10: Eighty-nine and forty-seven thousandths is written as

- 58.8% \*A. 89.047  
22.9% B. 89.0047  
9.2% C. 89.470  
9.0% D. 89.47

The following question is at the application level and measures ability to identify and use proportional ratios.

Question 5: Louis wins 6 Star Wars figures for each 5 that Pam wins. If Louis has 24 Star War figures, then Pam has

- 16.5% A. 30  
10.5% B. 25  
63.3% \*C. 20  
9.5% D. 18

The average score for the 11 questions on numeration is 55.4%.

Question 1, requiring students to identify place value in the hundredths place, was found to be the easiest (67.0% of the students answered correctly).

Question 8, requiring students to express 0.7 as a per cent, was found to be the most difficult (35.3% of the students answered correctly).

## Operations and Properties

Questions related to Operations and Properties measure ability to:

- add and subtract whole numbers and decimals
- multiply whole numbers and decimals using one-, two- and three-digit multipliers
- estimate products
- divide whole numbers and decimals using two- and three-digit whole number divisors
- check division by multiplication
- mentally compute simple division
- calculate averages and percentages
- understand and use specific strategies under the four basic steps associated with the problem-solving process

The following question is at the comprehension level and measures ability to divide whole numbers and decimals using three-digit whole number divisors.

Question 18: Divide       $343 \overline{)8111.95}$

- 11.1% A. 23.7  
13.7% B. 32.53  
59.8% \*C. 23.65  
14.0% D. 24.65

The following question is at the application level and measures ability to solve problems involving addition of whole numbers and decimals.

Question 14: Metal A melts at  $1420.7^{\circ}\text{C}$ . Metal B melts at a temperature of  $150.5^{\circ}\text{C}$  higher than metal A. The temperature that metal B melts at is

- 15.3% A.  $1270.2^{\circ}\text{C}$   
67.3% \*B.  $1571.2^{\circ}\text{C}$   
9.9% C.  $1581.2^{\circ}\text{C}$   
7.0% D.  $1671.2^{\circ}\text{C}$

The average for the 15 questions on operations and properties is 68.2%.

Question 12, requiring students to subtract three-digit whole numbers, was found to be the easiest (86.5% of the students answered correctly).

Question 20, requiring students to divide a four-digit whole number using a one-decimal-place divisor, was found to be the most difficult (43.4% of the students answered correctly).

## Measurement

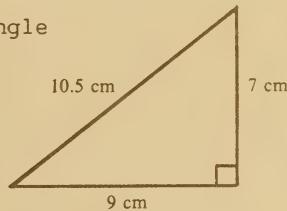
Questions related to Measurement measure ability to:

- find perimeter of rectangles with formulas
- find area of triangles and rectangles using formulas
- find volume of rectangular solids with and without using formulas
- read and determine distances according to a scale
- read the 24 hour clock
- understand and use the system of metric prefixes including use of symbols: kilo, hecto, deca, BASIC UNITS, deci, centi, milli
- express equivalent measures within units of length

The following question is at the comprehension level and measures ability to find area of triangles using formulas.

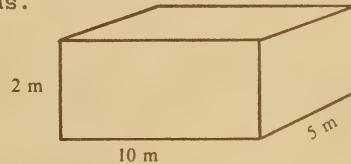
Question 28: The area of the right-angle triangle at the right is

- 31.5% A.  $63 \text{ cm}^2$   
9.6% B.  $47.25 \text{ cm}^2$   
49.7% \*C.  $31.5 \text{ cm}^2$   
8.3% D.  $36.75 \text{ cm}^2$



The following question is at the application level and measures ability to find volume of rectangular solids using formulas.

Question 31: An aquarium has dimensions as shown at the right. The smallest number of aquariums you would need to store  $200 \text{ m}^3$  of water is



- 8.5% A. 1 aquarium  
62.1% \*B. 2 aquariums  
14.9% C. 3 aquariums  
14.1% D. 4 aquariums

The average score for the nine questions on measurement is 57.0%.

Question 35, requiring students to express equivalent measure within units of length, was found to be the easiest (73.1% of the students answered correctly).

Questions 27, requiring students to solve a word problem that involves finding the perimeter of a rectangle using a formula, was found to be the most difficult (38.8% of the students answered correctly).

Student scores on questions involving perimeter and area of polygons is considerably below the test average (average for three questions is 44.1%).

## Geometry

Questions related to Geometry measure ability to:

- construct and draw prisms
- translate and rotate two-dimensional figures
- identify and test congruency using translations (slides) and reflections (flips)
- identify and name perpendicular lines

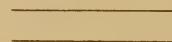
The following question is at the knowledge level and measures ability to identify perpendicular lines.

Question 39: Which diagram below shows perpendicular line segments?

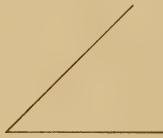
51.4% \*A.



26.2% B.



10.9% C.



11.2% D.



The following question is at the application level and measures the ability to identify and test congruency using reflections.

Question 38: A flip of the word at the right is

**SPACE**

4.3% A. **SPACE**

61.5% \*B. **SPACE**

11.6% C. **ECAPS**

22.5% D. **ECAPS**

The average for the five questions on geometry is 58.3%.

Question 36, requiring students to determine the number of edges in a cube, was found to be the easiest (63.1% of the students answered correctly).

Question 39, requiring students to identify perpendicular line segments, was found to be the most difficult (51.4% of the students answered correctly).

### Graphing

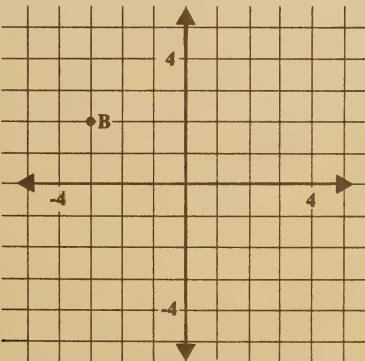
Questions related to Graphing measure ability to:

- construct bar graphs
- interpret and solve problems using pictographs and circle graphs
- locate points in the second quadrant
- generate and graph ordered pairs from a given relationship (no negative numbers)

The following question is at the comprehension level and measures ability to locate points in the second quadrant.

Question 44: The co-ordinates for point B are

- 59.4% \*A. (-3, 2)  
14.3% B. (-3, -2)  
19.9% C. (2, -3)  
5.8% D. (-2, -3)



The following question is at the application level and measures ability to solve problems using pictographs.

Use the information below to answer question 43.

NUMBER OF STUDENTS PARTICIPATING IN AFTER-SCHOOL ACTIVITIES

Minor Hockey	
Figure Skating	
Brownies	
4-H	
Cubs	 <div style="border: 1px solid black; padding: 5px; margin-left: 20px;"> = 5 students</div>

Question 43: Mrs. Holmes wants to take all the Brownies for a weekend camp-out. If one car can carry 6 students and the driver, how many cars will be needed?

- 8.1% A. 1
- 28.4% B. 3
- 55.5% \*C. 4
- 7.6% D. 6

The average score for the five questions on graphing is 59.1%.

Question 41, requiring students to complete a bar graph, was found to be the easiest (87.8% of the students answered correctly).

Questions 42, requiring students to interpret and solve a problem using a circle graph, was found to be the most difficult (26.1% of the students answered correctly).

### Results for Individual Questions

The percentage of students choosing each alternative for each question is given in Table 5. The correct response for each question is also identified.

Table 5  
Results for Individual Questions

Question Number	Correct Response	Distribution of Responses in %*				Question Number	Correct Response	Distribution of Responses in %*			
		A	B	C	D			A	B	C	D
1	B	8.8	67.0	3.2	21.0	24	A	67.7	12.5	11.2	6.8
2	D	5.2	30.5	11.8	52.6	25	A	67.7	7.5	8.2	14.7
3	C	28.6	8.8	53.7	8.5	26	D	12.1	15.1	16.5	53.6
4	B	11.9	53.0	20.9	14.0	27	A	38.8	44.1	3.6	13.4
5	C	16.5	10.5	63.3	9.5	28	C	31.5	9.6	49.7	8.3
6	D	7.4	15.8	12.2	63.8	29	C	26.9	17.5	43.7	11.5
7	A	58.6	18.3	8.4	14.2	30	C	17.5	18.3	60.4	3.7
8	D	14.2	42.6	7.9	35.3	31	B	8.5	62.1	14.9	14.1
9	A	40.9	11.2	22.5	24.2	32	D	16.9	6.5	11.3	65.1
10	A	58.8	22.9	9.2	9.0	33	A	57.2	34.2	1.6	6.9
11	D	11.2	8.8	21.2	58.7	34	B	17.8	61.9	13.2	6.9
12	B	1.8	86.5	5.6	6.0	35	C	10.5	5.9	73.1	10.3
13	B	11.8	79.2	6.8	2.1	36	B	15.3	63.1	14.0	7.4
14	B	15.3	67.3	9.9	7.0	37	D	7.8	14.9	22.3	54.8
15	C	5.0	7.4	82.5	4.7	38	B	4.3	61.5	11.6	22.5
16	C	6.7	9.8	79.0	4.1	39	A	51.4	26.2	10.9	11.2
17	B	10.2	66.8	15.2	7.2	40	B	7.4	61.0	7.4	24.0
18	C	11.1	13.7	59.8	14.0	41	D	1.3	2.5	8.2	87.8
19	A	70.0	10.5	10.8	8.0	42	A	26.1	42.2	11.1	19.9
20	C	7.4	42.2	43.4	5.8	43	C	8.1	28.4	55.5	7.6
21	D	5.3	10.7	8.5	74.1	44	A	59.4	14.3	19.9	5.8
22	D	11.7	10.4	13.2	63.2	45	D	8.3	8.2	15.6	67.1
23	A	59.6	17.4	18.7	2.9						

\* Percentages for a given question do not add to 100% because the "no response" category has been omitted. This is less than 3% for all questions.

### Comparison with the 1978 MACOSA Results

In 1978, a similar achievement test was administered to Grade 6 mathematics students in Alberta. Ten questions from the 1978 test are on the 1983 test. The common questions are distributed across three subject strands. The number of questions in each strand and the provincial averages for 1978 and 1983 are presented in Table 6.

Table 6

#### Provincial Averages for Common Questions: 1978 and 1983

Subject Strand	Number of Questions	Averages in Per Cent 1978	Averages in Per Cent 1983
Operations and Properties	5	63.8	71.5
Measurement	3	53.9	59.0
Geometry	2	32.2	53.1
Total	10	54.5	64.1

### Comparison with the 1982 Grade 3 Mathematics Results

Four questions from the 1982 Grade 3 Mathematics Achievement Test are on the 1983 Grade 6 test. There is one question from each strand except Graphing. The question numbers from the Grade 6 test are 7, 12, 30, and 36. The averages for these questions are as follows:

Grade 3	Grade 6
45.3%	67.2%

It is not possible to make direct comparisons between Grades 3 and 6 on knowledge of basic facts because the tests were administered under different conditions. Grade 3 students were allowed more time per question and they marked their answers directly in the test booklet. The upper limits for the products and dividends are 18 for the Grade 3 test and 81 for the Grade 6 test.

## Section II - Basic Facts

The basic facts tests measure quick recall of basic facts in addition to  $9 + 9$ , subtraction to  $18 - 9$ , multiplication to  $9 \times 9$ , and division to  $81 \div 9$ . One example for each, with the percentage of students selecting each alternative, is given below. The asterisk (\*) indicates the correct response and NR denotes no response.

Addition	Subtraction	Multiplication	Division
$6 + 5 = \underline{\hspace{2cm}}$	$15 - 8 = \underline{\hspace{2cm}}$	$8 \times 8 = \underline{\hspace{2cm}}$	$63 \div 7 = \underline{\hspace{2cm}}$
94.3% *A. 11	3.8% A. 6	1.1% A. 16	3.1% A. 6
1.4% B. 12	90.8% *B. 7	1.2% B. 32	3.3% B. 7
1.6% C. 13	3.1% C. 9	5.4% C. 48	6.5% C. 8
0.4% D. 30	0.6% D. 10	91.7% *D. 64	86.0% *D. 9
2.3% NR	1.7% NR	0.6% NR	1.1% NR

The initial analysis revealed that a large number of students did not finish the basic facts tests, indicating that the allowed writing time was too short. One possible reason for this is that students may have found it difficult to transfer answers to the answer sheet in such a short time. The percentage of students who were able to answer all the questions correctly is given below for each test:

Addition - 17.2%  
Subtraction - 11.2%  
Multiplication - 28.8%  
Division - 20.3%  
Mixed Operations - 20.9%

Consequently, the number of questions in each test was reduced for the final analysis. Test questions that were attempted by approximately 90% of the students were retained for analysis. The number of questions retained for analysis and the percentage of students completing each basic facts test are presented in Table 7.

Table 7  
Student Completion of Basic Facts Tests

Test	Number of Questions	Percentage of Students Completing Test
Addition	8	91.4
Subtraction	8	92.8
Multiplication	16	90.5
Division	14	90.4
Mixed Operations	14	92.4

Provincial averages based on these new test lengths are presented in Table 8.

Table 8  
Provincial Averages for Basic Facts Tests

Test	Number of Questions	Average (%)
Addition	8	94.1
Subtraction	8	90.8
Multiplication	16	90.5
Division	14	86.3
Mixed Operations	14	88.3

It is of interest to note not only average scores but also the number of students who achieved mastery. An 80% mastery level, for example, corresponds to answering at least 80% of the questions correctly. The percentages of students who achieved the 80% and 100% mastery levels are given in Table 9.

Table 9

Percentages of Students Achieving Mastery  
on Basic Facts Tests

Test	Percentage of Students	
	80% Mastery	100% Mastery
Addition	94.4	72.9
Subtraction	90.9	62.8
Multiplication	84.5	51.2
Division	80.7	45.8
Mixed Operations	83.7	45.0

Concluding Observations

The average for the total test is close to the target of 60%. The average for Operations and Properties is above the upper limit of the target region whereas the average for Numeration is below the lower limit of the target region. The averages for Measurement, Geometry, and Graphing are within the ranges of the target regions.

